An Introduction to the LDCM Grid Prototype

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LDCM Grid Prototype Introduction

- A Grid infrastructure allows scientists at resource-poor sites access to remote resource-rich sites
  - Enable greater scientific research
  - Maximize existing resources
  - Limit expenses
- The objective of the LDCM Grid Prototype (LGP) is to assess the applicability and effectiveness of a data grid to serve as the infrastructure for research scientists to generate virtual Landsat-like data products

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LGP Key POCs

- **Sponsors**
  - LDCM - Bill Ochs, Matt Schwaller
  - Code 500/580 - Peter Hughes, Julie Loftis
- **LGP Team members**
  - Jeff Lubelczyk (Lead)
  - Gail McConaughy (SDS Lead Technologist)
  - Beth Weinstein (Software Lead)
  - Ben Kobler (Hardware, Networks)
  - Eunice Eng (Software Dev, Data)
  - Valerie Ward (Software Dev, Apps)
  - Ananth Rao ([SGT] Software Arch/Dev, Grid Expertise)
  - Brooks Davis ([Aerospace Corp] Globus/Grid Admin Expert)
  - Glenn Zenker ([QSS] System Admin)
- **USGS**
  - Stu Doescher (Mgmt)
  - Chris Doescher (POC)
  - Mike Neiers (Systems Support)
- **Science Input**
  - Jeff Masek, 923 (Blender)
  - Robert Wolfe, 922 (Blender, Data)
- **LDCM Prototype Liaison**
  - Harper Prior [SAIC]
- **CEOS grid working group (CA)**
  - Ken McDonald
  - Yonsook Enloe [SGT]

High Level Schedule

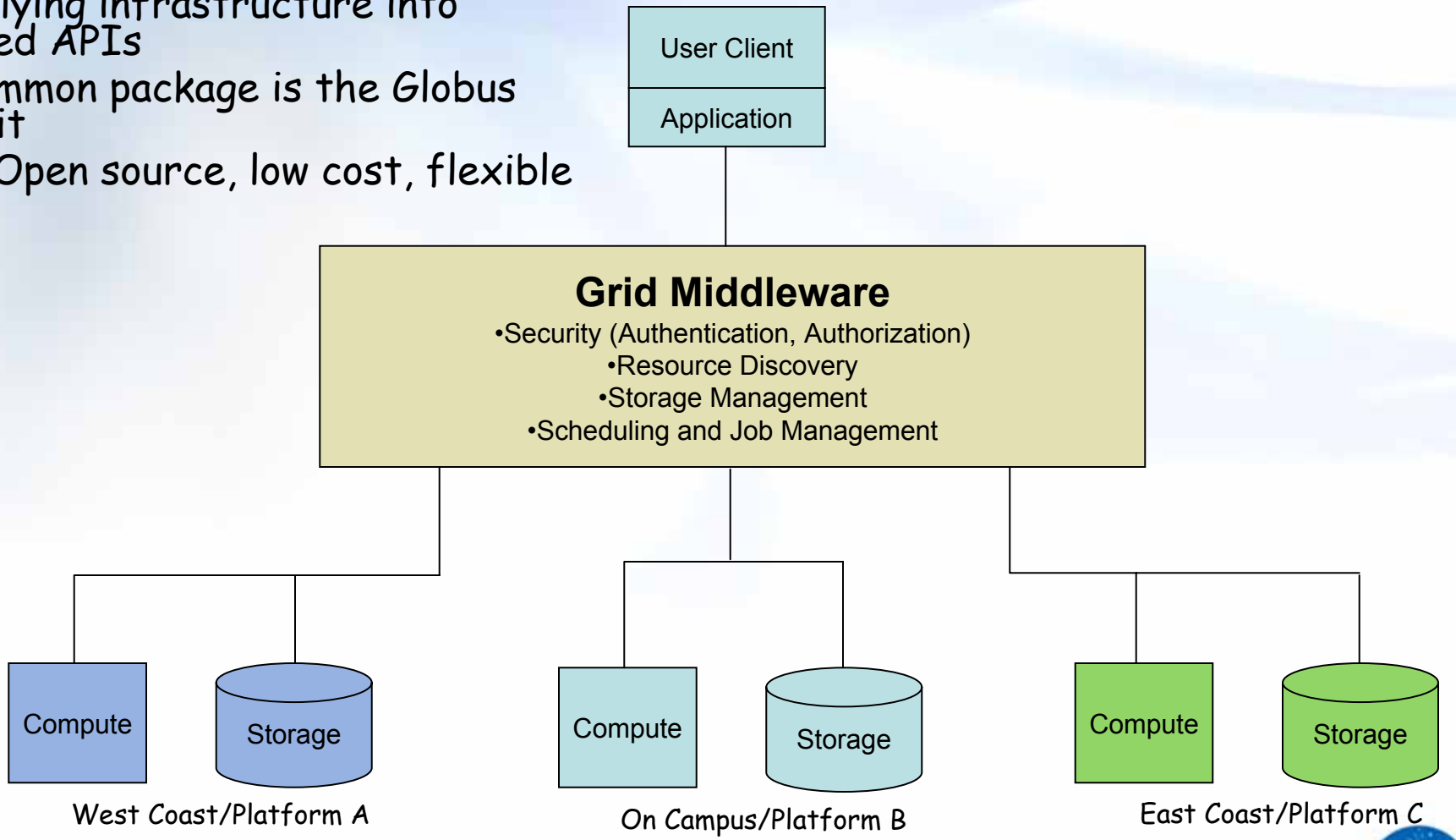
- **Major Milestones**
  - 12/03 - Prototype start
  - 6/04 - Demo of Capability 1 grid infrastructure
    - Demonstrate simple file transfers and remote application execution at multiple GSFC labs and USGS EDC
    - Ready to build application on top of basic infrastructure
  - 12/04 - Demo of Capability 1
    - Provide and demonstrate a grid infrastructure that enables a user program to access and process remote heterogeneous instrument data at multiple GSFC labs and USGS EDC
  - 3/05 - Demo of Capability 2 grid infrastructure
    - Demonstrate file transfers and remote application execution at multiple GSFC labs, USGS EDC, and ARC/GSFC commodity resources to assess scaleability
  - 6/05 - Demo of Capability 2
    - Enable the data fusion (blender) algorithm to obtain datasets, execute, and store the results on any resource within the Virtual Organization (GSFC labs, USGS EDC, ARC/GSFC)

What is a data grid?

- In an article titled "Anatomy of the Grid," Ian Foster of Argonne National Labs suggests the following (2000):
  - "The sharing that we are concerned with is not primarily file exchange but rather direct access to computers, software, data, and other resources, as is required by a range of collaborative problem solving and resource-brokering strategies emerging in industry, science, and engineering. This sharing is, necessarily, highly controlled, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs. A set of individuals and/or institutions defined by such sharing rules form what we call a *virtual organization*."
- He further suggests the following criteria:
  - Coordinates resources that are not subject to centralized control
  - Uses standard, open, general purpose protocols and interfaces
    - Otherwise, its an application specific system
  - Delivers nontrivial quality of service
    - Allows resources to be used in a coordinated fashion to deliver varying levels of service

Grid - A Layer of Abstraction

- Grid middleware packages the underlying infrastructure into defined APIs
- A common package is the Globus Toolkit
  - Open source, low cost, flexible



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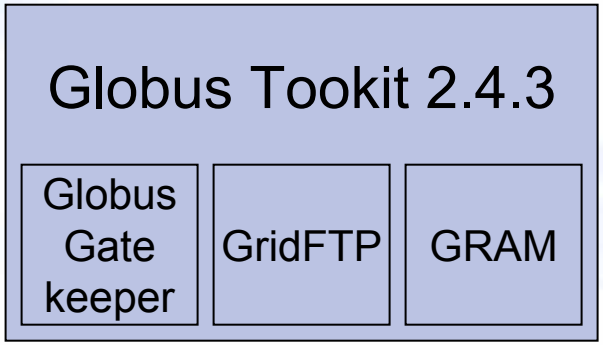
What the current LGP data grid utilizes

- **Security Infrastructure**
  - Globus Gate Keeper
    - Authentication (PKI)
    - Authorization
- **Resource Discovery**
  - Monitoring and Discovery Service (MDS) [LDAP like]
- **Storage Management and Brokering**
  - Metadata catalogs
  - Replica Location Service
    - Allows use of logical file names
      - Physical locations are hidden
  - Storage Resource Management
    - GridFTP
      - Retrieves data using physical file names
    - Data formats and subsetting
- **Job Scheduling and Resource Allocation**
  - GRAM (Globus Resource Allocation Manager) -- Provides a single common API for requesting and using remote system resources



Note: Portions of the Globus Toolkit used in Capability 1

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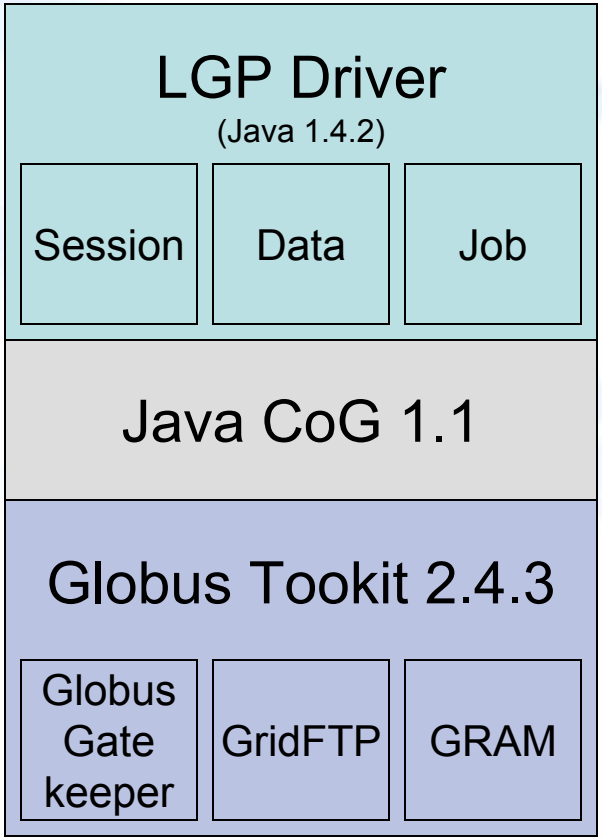
Capability 1 Software Framework

- LDCM Grid Prototype (LGP) Driver
  - Provides a generic software system architecture based on Globus services
  - LGP Driver high-level services
    - **Session Manager** – grid session initiation and user authentication using proxy certificates
    - **Data Manager** – file transfer using GridFTP
    - **Job Manager** – job submission and status in a grid environment
- **Utilizes the Java Commodity Grid Kits (CoGs)**
  - Supplies a layer of abstraction from underlying Globus services
  - Simplifies the programming interface



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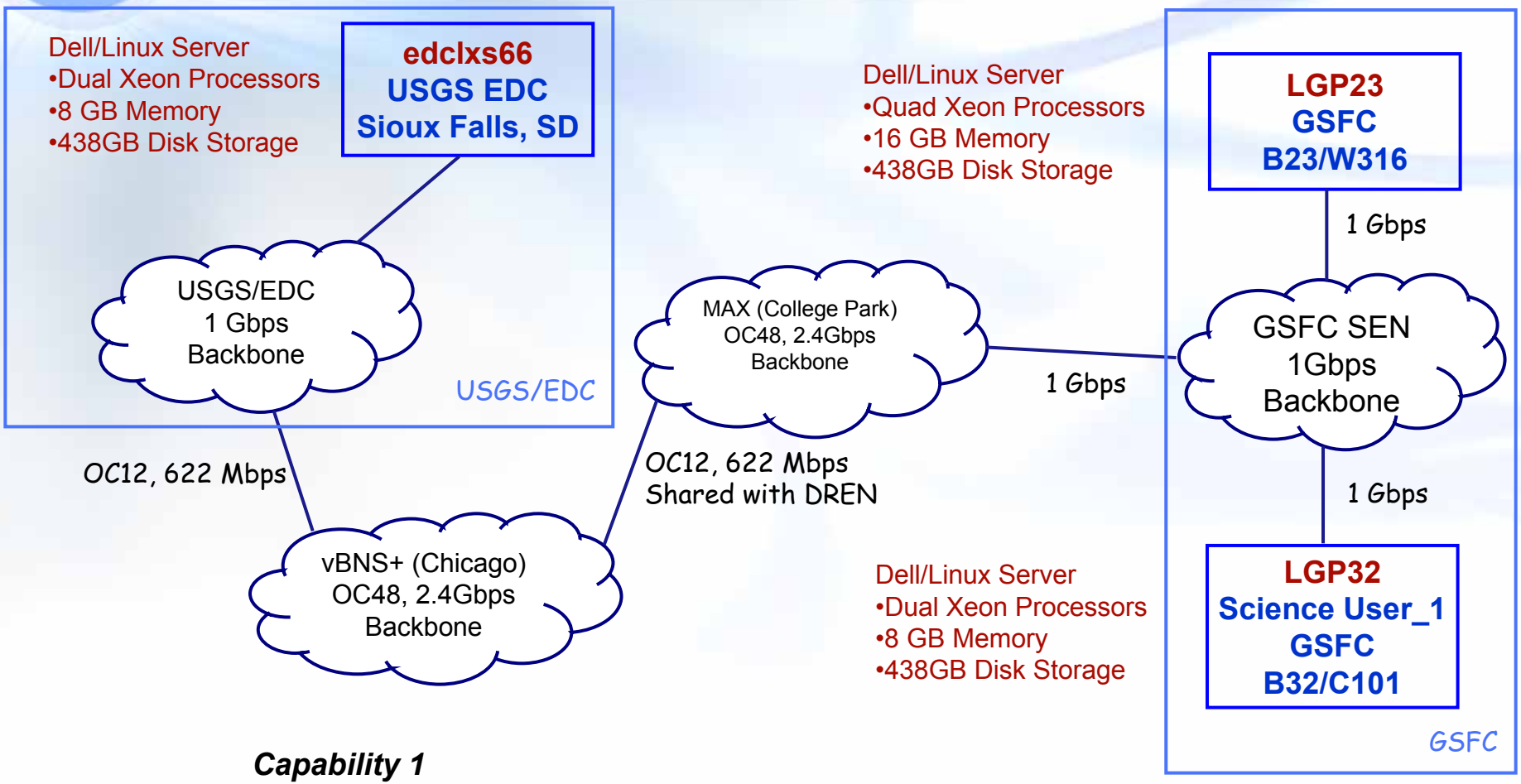
Capability 1 Virtual Organization



Capability 1

Installed Equipment

SEN: Science and Engineering Network
MAX: Mid-Atlantic Crossroads
DREN: Defense Research and Engineering Network
vBNS+: Very high Performance Network Service

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4 Scenarios to Illustrate Grid Flexibility

- **Data Services** ***(Move application to data)***
  - Transfer MRT components to remote hosts and process the data remotely, sending the results back to the science facility
- **Batch Execution** ***(Parallel computing)***
  - Demonstrate the execution of MRT components in a parallel batch environment
- **Local Processing** ***(User prefers to process locally)***
  - Transfer the selected data sets to the science user site for processing
- **Third Party Processing** ***(No local resource usage)***
  - Perform a third party data transfer and process the data remotely

Grid flexibility maximizes science resources

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Next Steps -- Capability 2

- **Capability 2 (C2)**
  - Integrate with the Blender team
    - Collaborate to identify meaningful C2 data sets
    - Demonstrate blender algorithm
  - Assess Grid performance
    - Expand the VO to include ARC supercomputing if available
    - Performance Goals
      - Demonstrate the processing of 1 day's worth of data in the grid environment (~250 scenes)
  - Grid Workflow -- increase automation
    - Our current capabilities allow us to submit jobs only to a specified resource
    - The goal of the next phase will be to provide the ability to submit a job to the "Grid" Virtual Organization
      - Grid resource management
      - Scheduling policy
      - Reliable job completion
      - Checkpointing and job migration
      - Leverage wasted cpu cycles